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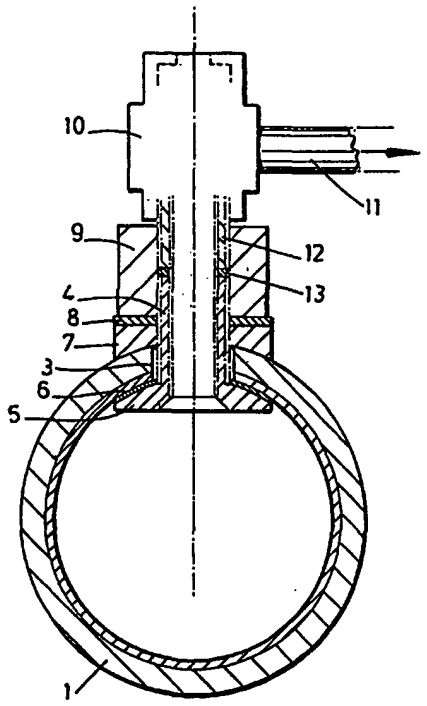
(54) Title: BRANCH-PIPE FERRULE AND METHOD OF INSERTING SAME IN A LINED MAINS-PIPE

(57) Abstract

A ferrule is inserted into an opening (18) formed in a wall of a lined pipe (1, 14) such that a tubular body (4) of the ferrule extends through the opening (18) and the liner (2) is trapped between the pipe (1, 18) and a flange (5) which is supported adjacent one end of the body (4). The ferrule is transported along the interior of the lined pipe from an open end of the pipe to adjacent the opening, the position of the ferrule relative to the opening being assessed visually. A tool is inserted through the opening to engage the ferrule body which is then pulled through the opening from outside the pipe and secured in position such that the flange (5) abuts the liner (2).



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# BRANCH-PIPE FERRULE AND METHOD OF INSERTING SAME IN A LINED MAINS-PIPE

The present invention relates to a method for inserting a ferrule into an opening formed in a wall of a lined pipe and to a ferrule suitable for use in that method.

There are many thousands of miles of ageing buried pipes in the United Kingdom and other countries the condition of which is such that they must either be replaced or relined. Where possible, relining is the preferred option for cost reasons. Various methods have been devised for inserting liners into pipes but all of the approaches adopted must address the problem of remaking connections to the lined pipe.

It is necessary to make openings in the lined pipe and to make connections to the lined pipe through those openings. This generally requires a component having a tubular body which can be inserted through an opening formed in a lined pipe and a flange which can engage against the inner surface of the liner so as to form a seal. Such components are generally referred to as ferrules and that term is used throughout this document.

Various ferrules have been designed which can be inserted from the outside of the pipe and then expanded such that a head of the ferrule forms a flange which engages against the edge of the liner around the opening. Such devices have certain advantages in that with appropriate associated equipment they can be used on under-pressure pipes, but in practice problems have been experienced in making reliable seals between the expanded head of the ferrule and the liner.

In particular, where liners are inserted into for example cast iron pipes, relatively thin walled liners can be used as the residual mechanical strength of the cast iron can provide support for the liner. Typically thin-walled liners are pulled into a pipe in folded form and then expanded by applying internal pressure. The liners must be sized so that they can be expanded effectively. If the liners are too large, they remain in a partially folded form. Unfortunately the internal diameter of cast iron pipes is often irregular and for example old cast iron pipes having a nominal internal

diameter of 100mm may have an internal diameter adjacent the pipe ends as small as 98mm and internal diameters at relatively thin-walled parts of their length as large as 108mm. A folded liner sized for such circumstances might have a nominal external diameter of 100mm, which means that there may be a significant gap between the liner and the internal wall of a pipe into which it is inserted. If an opening is then formed through the pipe and the liner where such a gap exists, and the liner is then clamped against the pipe wall, when the pipe is subsequently pressurised the liner will stretch until it is supported by the pipe. As a result the size of the opening in the liner will increase in the circumferential direction of the pipe. This will not be a problem if the ferrule flange is sufficiently wide to ensure sufficient overlap between the flange and the edge of the opening in the liner. It is difficult however to provide wide flanges in devices which rely upon expansion of a ferrule head after insertion of the ferrule through an opening in the pipe.

Considerable efforts have been expended in improving the design of ferrules with expanding heads so as to overcome the problems outlined above. Industry has focused on such devices as they may be used in under-pressure ferrule installations, but there are many circumstances in which ferrules can be inserted when the pipe is not under pressure. The present invention is concerned with the insertion of ferrules in such circumstances.

According to the present invention, there is provided a method for inserting a ferrule into an opening formed in a wall of a lined pipe such that a tubular body of the ferrule extends through the opening and the liner is trapped between the pipe and a flange which is supported adjacent one end of the body, wherein the ferrule is transported along the interior of the lined pipe from an open end of the pipe to adjacent the opening, the ferrule body is pulled through the opening from outside the opening, and the ferrule body is secured in position relative to the pipe such that the flange abuts the liner.

The ferrule body may be pulled through the opening by inserting a tool through the opening into engagement with the ferrule and then withdrawing the tool from the opening such that the ferrule body is pulled by the tool through the opening.

For example the ferrule body may be internally threaded and the tool may be externally threaded to enable it to be screwed into engagement with the ferrule. Alternative arrangements are possible however. For example a tool may be provided which is engageable by a push fit in the ferrule body, the engagement being sufficiently secure to enable an operator to pull the ferrule body on the tool through the opening. Alternatively the ferrule body may be engaged by for example hooking a tool directly onto the ferrule body or onto a member extending from the ferrule body and then pulling the ferrule through the opening by manipulation of the tool.

The opening may be formed in an upper portion of the lined pipe and the ferrule may be transported such that it assumes a position flange downwards in a lower portion of the pipe, the position of the ferrule relative to the opening being determined visually by looking into the pipe through the opening. The axial position of the ferrule within the pipe may be controlled by an elongate member such as a push rod. The ferrule may be secured in position by a nut which is screwed on to an external thread defined by the ferrule body.

The present invention also provides a ferrule for insertion into an opening of predetermined diameter formed in a wall of a lined pipe in accordance with a method as defined above, the ferrule comprising an externally threaded tubular body supporting a flange the outside diameter of which is substantially greater than the diameter of the opening.

The body may be internally threaded, the internal and external threads being of opposite hand. A nut may be screwed onto the external thread of the ferrule body to secure it in position. A shaped washer may be interposed between the nut and the external surface of the pipe, the shaped washer defining one surface which mates with the external surface of the pipe and an opposed surface which is transverse to the length of the ferrule body. A connector may also be screwed into the nut, a sealing washer being provided within the nut to form a seal between an end of the ferrule body remote from the flange and an end of the connector which is screwed into the nut.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view through a lined pipe into which a ferrule in accordance with the present invention has been inserted;

Figure 2 is a schematic representation of the method of insertion of a ferrule in accordance with the present invention;

Figure 3 is a plan view of a ferrule carrier shown in Figure 2 on which a ferrule is supported; and

Figure 4 is a side view of the carrier of Figure 3 in the direction of arrows 4.4 of Figure 3 with the ferrule being shown partly cut away.

Referring to Figure 1, a cast iron pipe 1 receives a polyethylene liner 2. In the illustrated example the liner 2 is a snug fit within the pipe 1 but this need not necessarily be the case. A circular opening 3 has been drilled through the pipe and the liner from outside the pipe. The opening 3 receives a ferrule comprising a ferrule body 4 which is threaded internally and externally and a flange 5 the outside diameter of which is substantially larger than the internal diameter of the opening 3. A resilient gasket 6 is interposed between the flange 5 and the inner surface of the liner 2.

A shaped washer 7 has a curved surface which mates with the cylindrical outer surface of the pipe 1 around the opening and a planar surface against which a spacer washer 8 bears. A nut 9 is screwed onto the external thread of the ferrule body 4 so as to compress the gasket 6 and the liner 2 between the flange 5 and the pipe 1. The end of the ferrule body remote from the flange 5 is located approximately midway along the axial length of the nut 9, the relative position of the nut on the ferrule body 4 being controllable by appropriate selection of spacer washers 8. This makes it possible for the assembly to be adapted for use with cast iron pipes of substantially different wall thicknesses.

A connector 10 coupled to a supply pipe 11 defines an externally threaded tubular body 12 which is screwed into the nut 9. A conventional ferrule designed for direct insertion into a threaded opening in a cast iron pipe has a tapered external thread to ensure a tight fit in such an opening. The connector 10 may be such a

conventional ferrule reworked to convert the tapered external thread into a parallel thread suitable for engagement by the nut 9. A resilient washer 13 of for example nylon is located inside the nut 9 between the ferrule body 4 and the connector portion 12 so as to form a reliable seal there between.

If the opening 3 was accessible manually from an open end of the pipe 1, it would be a simple matter to insert the ferrule illustrated in Figure 1. Typically however this is not possible as the opening 3 may be many metres from an available open pipe end. Figure 2 illustrates a method by which the ferrule of Figure 1 may be assembled assuming the opening 3 is remote from an available open pipe end.

Referring to Figure 2, a pipe 14 is shown as extending between excavations 15 and 16. A further excavation 17 is formed in a region of the pipe where an opening 18 is required to make a branch connection. One end of the pipe has connected to it a flexible pipe 19 which extends to a rod dispensing roller 20. A rod 21 extends through the pipe 19 into the pipe 14 and has attached to its end a carrier 22 on which the ferrule body is supported.

Referring to Figures 3 and 4, it can be seen that the carrier 22 is boat-like, having a lower surface which enables it to slide readily over the smooth inner surface of the liner 2. A ferrule 23 is located on a pin 24 extending from an upper surface of the carrier. A J-shaped clamp which is pivotal about a pin 26 is biased towards a pin 27 by a tension spring 28 extending between the clamp 25 and a further pin 29. Pivotal movement of the clamp 25 around the pin 26 biases the ferrule 23 against the pin 24, thereby securely clamping the ferrule on the carrier 22.

The carrier 22 is connected to a bracket 30 supporting a pin 31. The pin may be inserted through for example an eye (not shown) in one end of the rod 21 shown in Figure 2, or through an eye in one end of a cable used to pull the carrier through the pipe.

Thus a ferrule may be moved along the pipe 14 in an orientation such that the ferrule body extends upwards and the flange is clamped on the carrier 22. Once the ferrule has been aligned with the hole 18, and this can be assessed visually by simply looking downwards through the hole 18, it is then necessary to pull the ferrule

upwards so that the ferrule body projects through the hole 18. This is achieved by inserting a tool (not shown) which may be engaged with an internal thread defined within the ferrule body. The internal thread is of opposite hand to the external thread such that the tool may be screwed into the ferrule body until a tip of the tool bears against the top of the pin 24 of the carrier 22. Further rotation of the tool pulls the ferrule upwards until it is clear of the clamp 25. The tool is then withdrawn through the opening 18 so that the ferrule body extends therethrough. The washers 7, 8 and the nut 9 shown in Fig. 1 may then be threaded over the tool and engaged around the ferrule body 4, and the nut 9 may be tightened down to secure the assembly in place. As the internal and external threads on the ferrule body 4 are of the opposite hand, rotation of the nut will not carry with it the risk of unscrewing the ferrule from the tool.

As an alternative to clamping the ferrule on the carrier, means may be provided to ensure that the ferrule body cannot rotate relative to the carrier 22. For example, the peripheral edge of the ferrule flange may be non-circular and may fit inside a mating non-circular recess in the carrier 22.

The washer 7 and the ferrule body 4 may be keyed together to ensure that they adopt the appropriate relative orientation so that an installer would know by appropriate positioning of the washer 7 on the external surface of the pipe that the flange 5 had also been appropriately positioned within the lined pipe.

The radius of curvature of the flange 5 may be selected to match that of the "average" cast iron pipe in which it may be inserted in order to minimise the variation in the gap between the flange and pipe which has to be accommodated by the gasket 6. For example, given a pipe internal diameter which may range between 98 and 108mm, and a liner 2 of thickness 3mm, the internal diameter of the liner surface against which the flange bears may vary between 95 and 105mm, and therefore a flange radius of curvature of 50mm would be appropriate.

## CLAIMS

1. A method for inserting a ferrule into an opening formed in a wall of a lined pipe such that a tubular body of the ferrule extends through the opening and the liner is trapped between the pipe and a flange which is supported adjacent one end of the body, wherein the ferrule is transported along the interior of the lined pipe from an open end of the pipe to adjacent the opening, the ferrule body is pulled through the opening from outside the opening, and the ferrule body is secured in position relative to the pipe such that the flange abuts the liner.

2. A method according to claim 1, wherein the ferrule body is pulled through the opening by inserting a tool through the opening into engagement with the ferrule, and withdrawing the tool from the opening such that the ferrule body is pulled by the tool through the opening.

3. A method according to claim 2, wherein the ferrule body defines an internal thread engageable by a threaded end of the tool, the tool being interengaged with the ferrule by screwing the threaded end of the tool into the body.

4. A method according to claim 1, 2 or 3, wherein the opening is formed in an upper portion of the lined pipe, the ferrule is transported such that it assumes a position flange downwards in a lower portion of the pipe, and the position of the ferrule relative to the opening is determined visually by looking into the pipe through the opening.

5. A method according to any preceding claim, wherein the ferrule is transported on a carrier which is moved along a pipe by an elongate member extending along the pipe from the open end of the pipe.

6. A method according to claim 5, wherein the elongate member is a rod connected to the carrier.

7. A method according to any preceding claim, wherein the ferrule is secured in position by a nut which is secured onto an external thread defined by the ferrule body.

8. A ferrule for insertion into an opening of predetermined diameter formed in a wall of a lined pipe in accordance with the method of any preceding claim, comprising an externally threaded tubular body supporting a flange the outside diameter of which is substantially greater than the diameter of the opening.

9. A ferrule according to claim 8, wherein the body is internally threaded, the internal and external threads being of opposite hand.

10. A ferrule according to claim 8 or 9, comprising a nut which may be screwed onto the external thread of the ferrule body.

11. A ferrule according to claim 10, comprising a washer through which the ferrule body extends, the washer being shaped to define a surface which mates with the outer surface of the pipe around the opening and an opposed surface transverse to the ferrule body.

12. A ferrule according to claim 10 or 11, comprising a sealing washer received within the nut to form a seal between the end of the ferrule body remote from the flange and a connector body screwed into the nut.

13. A method for inserting a ferrule into an opening formed in a wall of a lined pipe substantially as hereinbefore described with reference to the accompanying drawings.

14. A ferrule substantially as hereinbefore described with reference to the accompanying drawings.

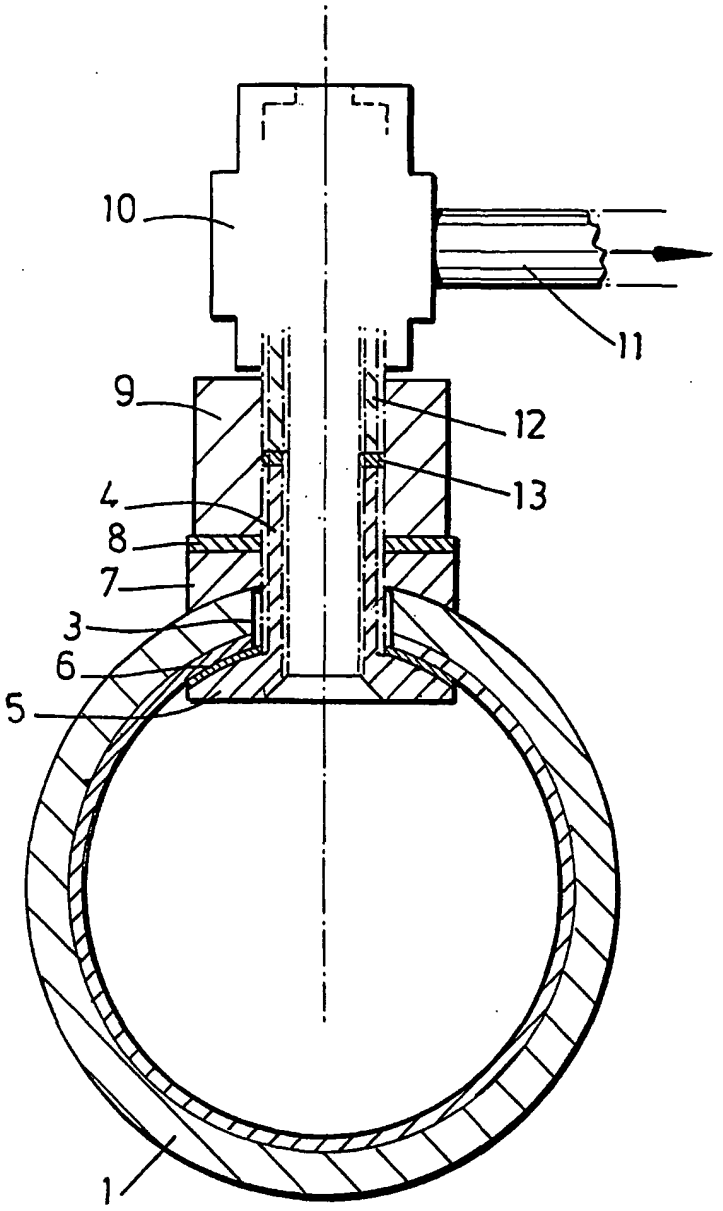


FIG. 1

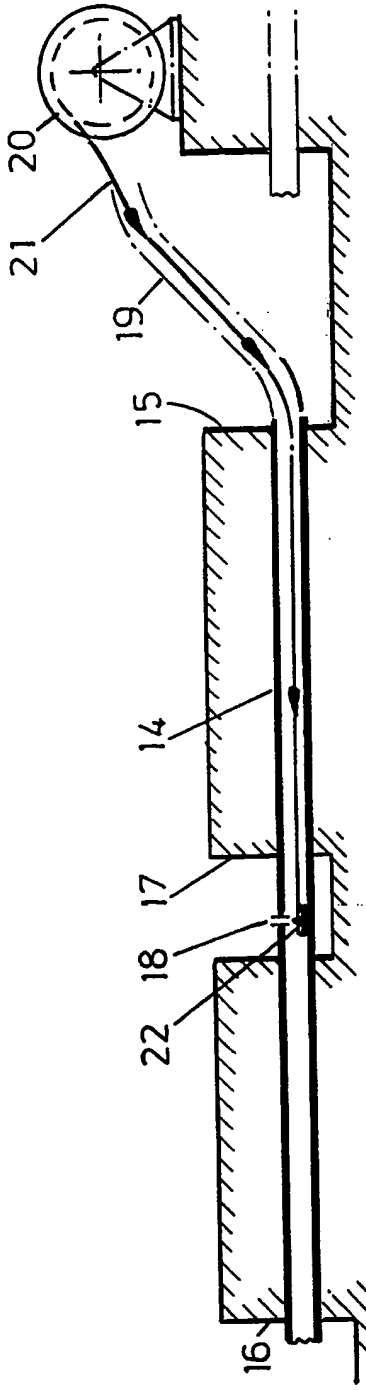


FIG. 2

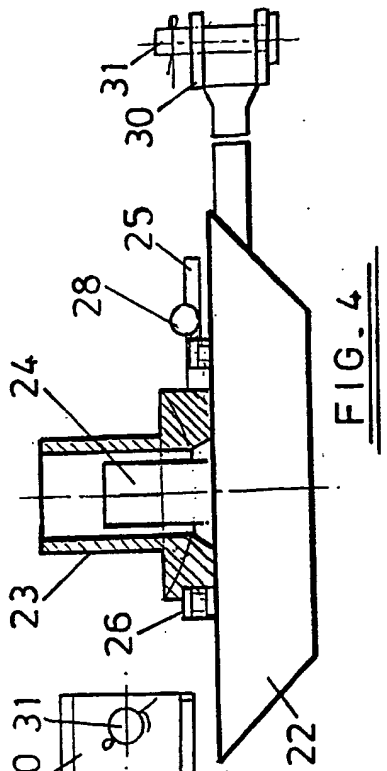


FIG. 4

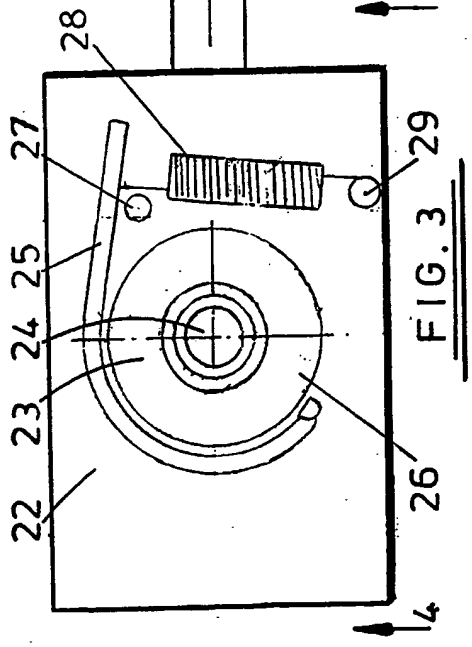


FIG. 3

# INTERNATIONAL SEARCH REPORT

Inter nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L55/16 F16L41/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| X<br><br>Y | DE 44 35 653 A (ANGUS FIRE ARMOUR LTD) 6 April 1995<br>see column 3, line 63 - column 4, line 9; figures 5-8 | 8-12<br><br>2,3 |
| Y | EP 0 407 575 A (ASHIMORI IND CO LTD) 16 January 1991<br>see page 8, line 20 - page 8, line 24; figure 1 | 5,6 |
| A | US 3 841 667 A (SANDS R) 15 October 1974<br>see abstract | 9 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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# INTERNATIONAL SEARCH REPORT

International application No.
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**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 13,14
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
Formulation of claims 13,14 vague and unclear.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/GB 99/00621

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